Chapter 7: Non-parametric models

Labcoat Leni's Real Research

Having a Quail of a Time?

Problem

Matthews, R. C. et al. (2007). *Psychological Science*, 18(9), 758-762.

We encountered some research in Chapter 2 in which we discovered that you can influence aspects of male quail's sperm production through 'conditioning'. The basic idea is that the male is granted access to a female for copulation in a certain chamber (e.g. one that is coloured green) but gains no access to a female in a different context (e.g. a chamber with a tilted floor). The male, therefore, learns that when he is in the green chamber his luck is in, but if the floor is tilted then frustration awaits. For other males the chambers will be reversed (i.e. they get sex only when in the chamber with the tilted floor). The human equivalent (well, sort of) would be if you always managed to pull in the Pussycat Club but never in the Honey Club. During the test phase, males get to mate in both chambers; the question is: after the males have learnt that they will get a mating opportunity in a certain context, do they produce more sperm or better-quality sperm when mating in that context compared to the control context? (That is, are you more of a stud in the Pussycat club? OK, I'm going to stop this anaology now.)

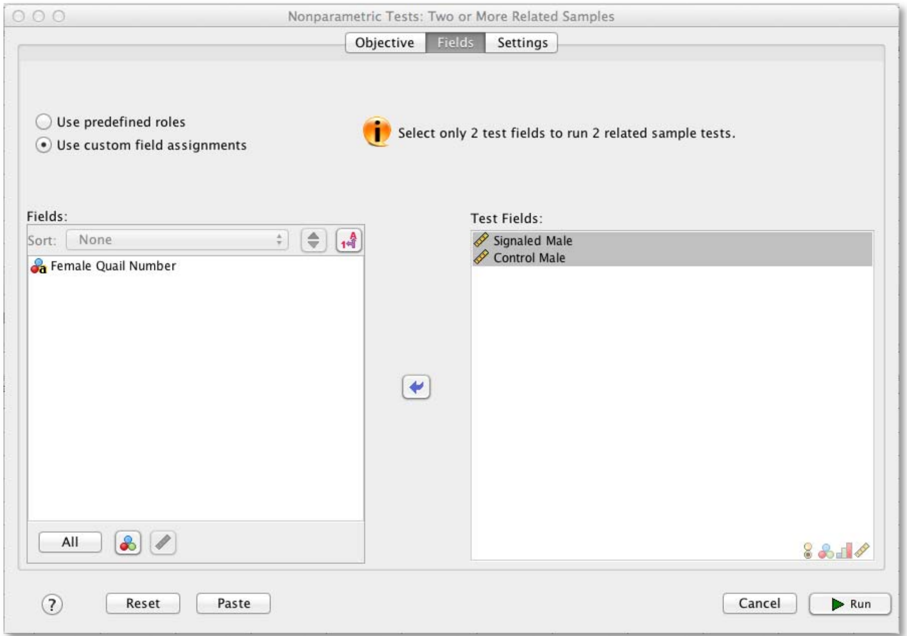
Mike Domjan and his colleagues predicted that if conditioning evolved because it increases reproductive fitness then males who mated in the context that had previously signalled a mating opportunity would fertilize a significantly greater number of eggs than quails that mated in their control context (Matthews, Domjan, Ramsey, & Crews, 2007). They put this hypothesis to the test in an experiment that is utter genius. After training, they allowed 14 females to copulate with two males (counterbalanced): one male copulated with the female in the chamber that had previously signalled a reproductive opportunity (**Signalled**), whereas the second male copulated with the same female but in the chamber that had not previously signalled a mating opportunity (**Control**). Eggs were collected from the females for 10 days after the mating and a genetic analysis was used to determine the father of any fertilized eggs.

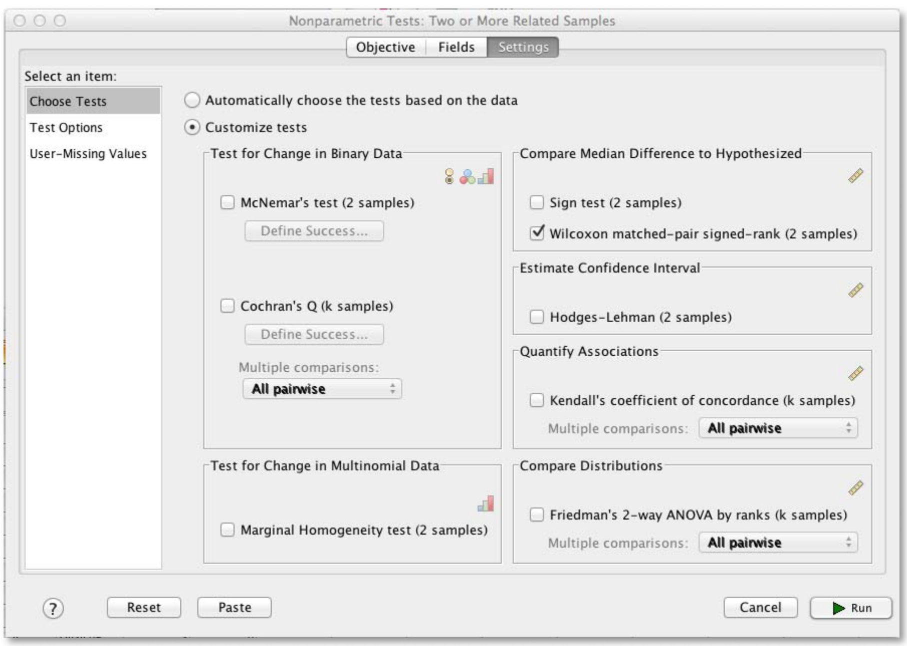
The data from this study are in the file **Matthews et al. (2007).sav**. Labcoat Leni wants you to carry out a Wilcoxon signed-rank test to see whether more eggs were fertilized by males mating in their signalled context compared to males in their control context.

Solution

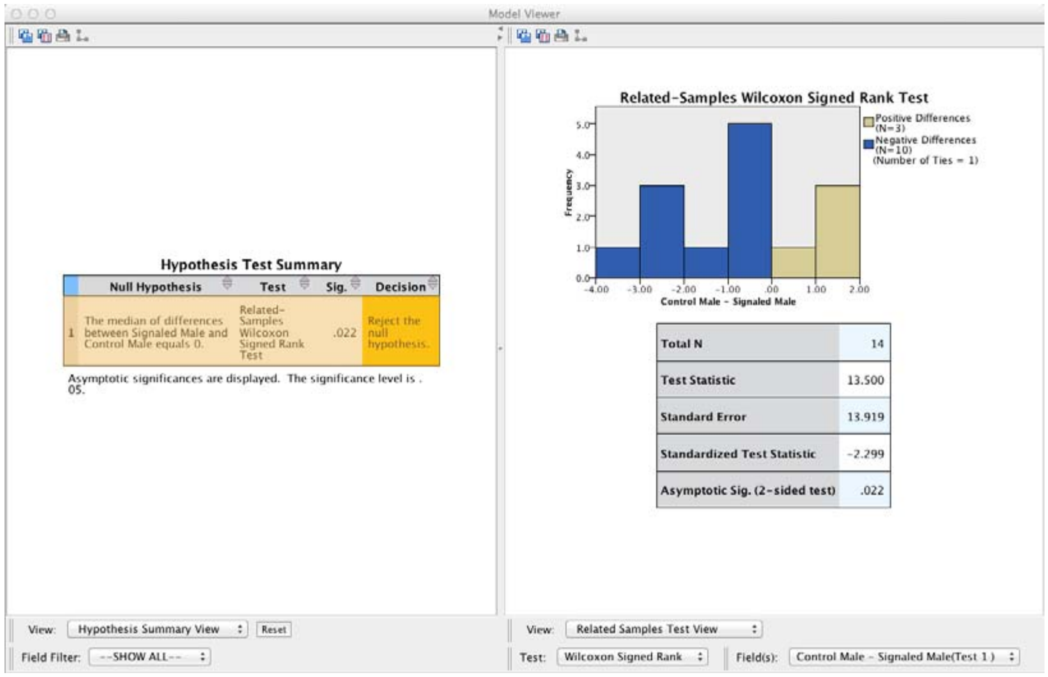
To run a Wilcoxon test you need to follow the general procedure outlined in the book chapter. First of all you need to select Analyze Nonparametric Tests ▸ Related Samples... . When you reach the

Objective Fields Settings tab you will see all of the variables in the data editor listed in the box labelled *Fields*. If you assigned roles for the variables in the data editor Use predefined roles will be selected and SPSS will have automatically assigned your variables. If you haven't assigned roles then Use custom field assignments will be selected and you'll need to assign variables yourself. Select both dependent variables from the list (click on **Signaled Male** then, holding down *Ctrl* (*Cmd* on a Mac), click on **Control Male** and drag them to the box labelled *Test Fields* (or click on). The completed dialog box is shown below. Next, select the Objective Fields Settings tab to activate the test options. You can let SPSS pick a test for you (Automatically choose the tests based on the data), but you have more options available if you select Customize tests. To do a Wilcoxon test check Wilcoxon matched-pair signed-rank (2 samples) and then click on Run to run the analysis.





The completed dialog boxes for running a Wilcoxon signed-rank test. (NB: These dialog boxes look strange because I was working on a Mac rather than a PC for this question. Don't worry though: apart from being grey scale rather than blue, they are basically the same.)



The summary table in the output above tells you that the significance of the test was .022 and suggests that we reject the null hypothesis. Double click on this table to enter the *model viewer*. Notice that we have different coloured bars: the brown bars represent positive differences (these are females that produced fewer eggs fertilized by the male in his signalled chamber than the male in his control chamber) and the blue bars negative differences (these are females that produced more eggs fertilized by the male in his signalled chamber than the male in his control chamber). We can see that the bars are predominantly blue. The legend of the graph confirms that there were 3 positive differences, 10 negative differences and 1 tie. This means that for 10 of the 14 quails, the number of eggs fertilized by the male in his signalled chamber was greater than for the male in his control chamber, indicating an adaptive benefit to learning that a chamber signalled reproductive opportunity. The one tied rank tells us that there was one female who produced an equal number of fertilized eggs for both males.

There is a table below the histogram that tells us the test statistic (13.50), its standard error (13.92), and the corresponding *z*-score (–2.30). The *p*-value associated with the *z*-score is .022, which means that there's a probability of .022 that we would get a value of *z* as large as the one we have if there were no effect in the population; because this value is less than the critical value of .05 we should conclude that there were a greater number of fertilized eggs from males mating in their signalled context, $z = -2.30$, $p < .05$. In other words, conditioning (as a learning mechanism) provides some adaptive benefit in that it makes it more likely that you will pass on your genes.

The authors concluded as follows:

Of the 78 eggs laid by the test females, 39 eggs were fertilized. Genetic analysis indicated that 28 of these (72%) were fertilized by the signalled males, and 11 were fertilized by the control males. Ten of the 14 females in the experiment produced more eggs fertilized by the signalled male than by the control male (see Fig. 1; Wilcoxon signed-ranks test, $T = 13.5$, $p < .05$). These effects were independent of the order in which the 2 males copulated with the female. Of the 39 fertilized eggs, 20 were sired by the 1st male and 19 were sired by the 2nd male.

The present findings show that when 2 males copulated with the same female in succession, the male that received a Pavlovian CS signalling copulatory opportunity fertilized more of the female's eggs. Thus, Pavlovian conditioning increased reproductive fitness in the context of sperm competition.' (p. 760)